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Sexual behavior risk compensation associated with HIV pre-exposure prophylaxis (PrEP) among men who have sex with men, The American Men's Internet Survey, 2019

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Abstract

Sexual behavior risk compensation associated with HIV pre-exposure prophylaxis (PrEP) among men who have sex with men, The American Men's Internet Survey, 2019

By Jessica Laury

Objective: Assess the impact of pre-exposure prophylaxis (PrEP) use on reported condomless anal intercourse (CAI).

Introduction: Pre-exposure prophylaxis (PrEP) is an effective, once daily oral pill indicated for populations at high risk of HIV transmission, including men who have sex with men (MSM). PrEP, when taken regularly, effectively prevents HIV transmission but does not protect against other non-HIV-STDs. PrEP users are still encouraged to practice safe sexual behaviors including wearing a condom during sex. It is possible that use of PrEP will result in risk compensation behavior in which PrEP users engage in riskier sexual behaviors, like CAI, because they feel protected by PrEP.

Methods: We analyzed data from the 2019 American Men's Internet Survey (AMIS), an annual online survey of HIV risk behaviors among MSM in the United States. The primary exposure of interest was PrEP use within the last 12 months and its association with CAI reported in the last 12 months. Univariate logistical regression models were developed to evaluate crude associations of CAI and PrEP use with education, age, insurance status, experienced stigma, income, and healthcare provider (HCP) use. Unadjusted and adjusted prevalence ratios comparing the prevalence of CAI among PrEP users and non-users were estimated using predicted margins logistic regression.

Results: Among 9,226 HIV-negative AMIS participants, 6,356 (69%) reported CAI in the last 12 months. In unadjusted models, education, age, insurance status, and experienced stigma were associated with reporting CAI. In the adjusted model, the prevalence of CAI was higher among PrEP-using MSM compared to non-users (PR: 1.31, 95% CI: 1.28-1.35).

Discussion: In this analysis, MSM who used PrEP in the past 12 months were more likely to report CAI after controlling for education, age, insurance status, experienced stigma, income, and HCP use. While these results suggest PrEP use may result in risk compensation behaviors, additional longitudinal studies are needed to assess the temporality of these associations, and external factors associated with PrEP use and CAI.

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Table of Contents:

Introduction

Human immunodeficiency virus (HIV) remains a key public health threat; as of 2018 there were over one million adults and adolescents living with HIV in the United States [1]. Gay, bisexual, and other men who have sex with men (MSM) experience disproportionate HIV incidence and accounted for 69% of the 37,968 new HIV diagnoses in the US in 2018. Strategies to reduce HIV incidence in the US have traditionally emphasized risk mitigation behaviors at the individual level like wearing condoms, knowing a partner's HIV status, and limiting the number of sexual partners. More recently, biomedical prevention interventions, including pre-exposure prophylaxis (PrEP), have created new opportunities for transmission reduction.

According to CDC guidelines, PrEP is indicated for adult men without HIV, not currently in a monogamous partnership with a recently tested, HIV-negative partner, who have had at least one male sex partner in the preceding six months, and who have had a bacterial STD (sexually transmitted disease) or reported condomless anal intercourse (CAI) in the past six months [2]. Following licensure in 2012, awareness and use of PrEP have increased from 47.4% to 80.6% and 1.7% to 19.9%, respectively, between 2013 and 2017 [3]. Despite increases in PrEP uptake, HIV incidence remained largely stable between 2014 and 2018 [4] while syphilis, gonorrhea and chlamydia rates increased steadily [5].

Consistent use of PrEP reduces the risk of HIV transmission between HIV-serodiscordant sex partners by 86-99% [6, 7, 8], and a modeling study estimates that widespread use among MSM could reduce HIV incidence by 49.4% [9]. PrEP efficacy is dependent on consistent adherence, defined for MSM as taking four daily doses or more per week [10]. PrEP does not protect against other sexually transmitted diseases (STDs) like chlamydia or gonorrhea, and decreased condom use following PrEP uptake might lead to increased incidence of STDs.

Risk compensation theory posits that individuals will change their behaviors based on perceived risk. As environmental factors change, the perceived risk associated with a behavior may fall below an individual's acceptable risk threshold and they may become comfortable with behaviors previously perceived as too risky. The theory has been demonstrated in injury prevention cases where the use of safety equipment resulted in employees reporting working more quickly and carelessly [11]. Conversely, concerns that HPV vaccination would increase risky sexual behaviors among children have been largely refuted in risk compensation studies [12]. Risk compensation theory suggests individuals taking PrEP correctly, who are at a lower risk for contracting HIV, may choose to engage in riskier sexual behaviors because of the protection provided by PrEP. Because PrEP does not protect against other STDs, which share common exposure pathways with HIV, increased risk behaviors among PrEP users may result in increases in other STDs. Additionally, PrEP efficacy is dependent on consistent use of the pill at least 4 days per week [27, 28]. Because PrEP efficacy is not immediate and is dependent on adherence, the assumed benefits of PrEP use may not always be in line with realized protection. Risk compensation behaviors may begin before sufficient doses of PrEP have been consumed to confer protection, or during a period of poor adherence.

Research directly evaluating PrEP users' knowledge of PrEP efficacy and limitations has been sparse but suggests functional knowledge of PrEP is high among users [13]. Previous studies investigating increases in risky sexual behavior following PrEP initiation have been inconclusive [14, 15, 16]. However, associations have been identified between higher educational attainment and income level and reduced condom use following PrEP initiation [17], suggesting direct changes in risk behavior as a result of PrEP use may vary across subpopulations of MSM. Some studies have suggested men are more willing to initiate PrEP if

they are already at higher risk of contracting HIV as a result of their sexual behaviors [18, 19]. This correlation may complicate assessments of risk compensation in studies that do not assess individual risk behavior before and after PrEP initiation.

There is also conflicting evidence surrounding an association between increases in the incidence of other STDs among PrEP users. Open label studies following PrEP efficacy trials have found associations between PrEP use and increases in chlamydia, gonorrhea, and syphilis [20, 21]. In contrast, other observational studies have identified no association between PrEP use and increases in STDs [22]. Large scale, longitudinal studies are needed to better understand associations between PrEP use and increased incidence of non-HIV STDs and to evaluate self-reported changes in risk behavior as a reliable proxy for STD infection risk.

Additionally, studies designed to investigate external factors which may influence PrEP access, perceived risk, and risk behaviors are needed. Barriers that threaten reliable PrEP access put typical PrEP users at elevated risk for contracting HIV, particularly if these barriers coincide with reduced condom use following PrEP initiation. Social stigma and cost of PrEP have been identified as key structural factors associated with PrEP adherence [23, 24]. Changes in PrEP access may leave users unknowingly or unavoidably under protected. Individual level factors such as forgetfulness, PrEP side effects, and reliable access to PrEP can also negatively impact consistency of use and ultimate efficacy. Overall, the majority of PrEP users adhere to dosage guidelines sufficiently to reliably prevent HIV infection [25]; however, lower educational attainment, younger age, and utilization of public insurance are associated with insufficient adherence and HIV incidence [26]. Minority race/ethnicity, lower education, and not reporting an HIV test within the last year are also associated with lower levels of functional PrEP knowledge [13]. Misunderstandings about PrEP may lead to miscalculations of personal risk and

risk compensation behaviors. Current research has been inconsistent concerning PrEP's role in sexual risk behavior, and large-scale studies considering relevant covariates like income, education, insurance, race, ethnicity and stigma have been limited.

We report results from the American Men's Internet Survey (AMIS), a cross-sectional survey of men who have sex with men in the United States. Our objective was to evaluate associations between PrEP use within the last 12 months and known risk behaviors specifically CAI. Additional factors of interest which may be associated with risk compensation behaviors among PrEP users include race, ethnicity, educational attainment, income level, age, and insurance status.

Methods

Study Population

The American Men's Internet Survey (AMIS) is conducted annually to collect data on HIV risk behaviors and access to HIV prevention and testing services among MSM in the United States. The data for this analysis were collected in the sixth cycle of the survey completed in 2019. Participants were not compensated for participation.

Participants were selected using convenience sampling via email blasts to previous AMIS participants and online advertisements posted on a variety of social and sexual networking websites and apps targeted to MSM. To be eligible participants must be at least 15 years old, cisgender male, be a United States resident, be able to complete the survey in English, and have a history of oral or anal sex with a man or identify as gay or bisexual. Interested individuals who met the inclusion criteria and gave informed consent were directed to the online self-administered AMIS questionnaire. AMIS study procedures were approved by the Emory University Institutional Review Board. Data were collected and stored on a secure server and protected under a federal certificate of confidentiality.

Measures

The outcome of interest for this study was self-reported (CAI) in the last 12 months. The primary exposure was PrEP use in the last 12 months. An assessment of previous literature was used to develop a directed acyclic graph (DAG; Figure 1) to inform the selection of additional control variables to be included in the model. The resulting model included: age (15-24, 25-29,30-39,40+ years of age), income ($0-$19999, $20000-$39999, $40000-$74999, $75000+), educational attainment (no college, at least some college), health insurance status (none, private,

public, multiple/other), use of a healthcare provider (HCP) in the last 12 months, and stigma. Stigma was assessed using the NHBS measure [29] which includes five questions concerning experiences of: verbal harassment; discrimination in businesses; discrimination at work; discrimination in a healthcare setting; and physical assault. Participants were asked if they experienced stigma in the last 12 months; a "yes" response to any of the five questions was coded as a "yes" for experienced stigma. CAI in the last 12 months, PrEP use in the last 12 months, HCP utilization, and experienced stigma were all binomial variables. For all questions, responses of "prefer not to answer", "don't know" and "does not apply" were recoded as missing. Individuals who have ever tested positive for HIV were excluded from analysis because individuals living with HIV are not candidates for PrEP.

Bivariate and Univariate Analysis

Descriptive statistics were calculated for demographic characteristics: age, race, income, education, insurance status, and health care utilization. Counts and percentages were calculated for each of the covariates stratified by CAI in the last 12 months. Univariate logistic regression models using the predicted margins method were estimated to evaluate the relationship between each covariate and CAI.

Multivariable Regression Analyses

A multivariable logistic regression model using the predicted margins method was used to estimate prevalence ratios for CAI in the past 12 months controlling for potential confounders identified in the literature: age, HCP use, insurance status, education, income, and stigma. The adjusted model was assessed for multicollinearity. There was no evidence of multicollinearity in

the model and all variables were retained in the model. The predicted margins approach was used to estimate prevalence ratios and 95% confidence intervals for PrEP use and CAI for both crude and adjusted models. A Hosmer-Lemeshow goodness of fit test was used to assess how well the final adjusted model fit the sample data. All analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC) and SUDAAN version 11.01.3 (RTI International, Research Triangle Park, NC).

Results

A total of 10,130 MSM completed the 2019 AMIS study; of these we excluded 903 who had previously been diagnosed with HIV and one who reported an age of 199. Of the 9,226 included participants, 6,356 (69%) reported CAI within the last 12 months (Table 1). The median age was 26 years (IQR 21-38). The study population was roughly representative consisting of white (61.7%), Black (11.8%), Hispanic (15.9%) and other/multiple race (10.5%) participants. The majority of respondents earned at least $40,000 annually (62.8%) and had at least some college education (76.5%). Most respondents had health insurance, but 8.88% were uninsured.

In unadjusted analyses education, insurance status, and age were associated with using PrEP in the past 12 months. Having at least some college education was associated with higher prevalence of PrEP use compared to individuals without any college education (PR: 2.31, 95% CI: 2.09-2.55; Table 2). Uninsured participants were less likely to have used PrEP in the past 12 months compared to those who were privately insured (PR: 0.44, 95% CI: 0.34-0.57). No meaningful differences were identified when comparing participants with public insurance or other insurance sources to those with private insurance, but individuals who reported seeing an HCP were 6.8 times more likely to report PrEP use (PR: 6.83, 95% CI: 4.88-9.55). Participants aged 25-29 years (PR:2.75, 95% CI: 2.39-3.16) and those aged 30-39 years (PR: 3.28, 95% CI: 2.84-3.77) were more likely to have used PrEP in the past 12 months compared to those aged 15-24 years. The prevalence of PrEP use was lower among those who had experienced stigma (PR: 0.84, 95% CI: 0.76-0.92; Table 2).

Education, age, and insurance status were associated with reporting CAI in the last 12 months. Participants who had at least some college education more frequently reported CAI compared to individuals who had never attended college (PR: 1.18, 95% CI: 1.14-1.23; Table 3).

Men ages 25-29 (PR: 1.18, 95% CI: 1.15-1.22) and 30-39 (PR:1.14, 95% CI: 1.10-1.19) reported CAI more frequently than men ages 15-24. Participants with public (PR: 0.95, 95% CI: 0.91-0.99) and other/multiple (PR: 0.88, 95% CI: 0.82-0.95) insurance providers had a lower prevalence of CAI compared to those with private insurance. Seeing an HCP within the last 12 months was not associated with CAI. Experiencing stigma was associated with a higher prevalence of CAI (PR: 1.05, 95% CI: 1.02-1.08).

Both crude and multivariable models supported an association between PrEP use and CAI. In unadjusted analyses, men who had used PrEP in the past 12 months were 34% more likely to report CAI in the same time period (PR: 1.34, 95% CI: 1.30-1.37) (Table 3). In the model adjusted for X, Y, and X, the association was modestly attenuated (PR: 1.31, 95% CI: 1.28-1.35).

Discussion

The results of this study suggest that MSM who have used PrEP in the last 12 months are also more likely to report having CAI during the same time period. This association remained stable after adjusting for confounding variables including age, income, educational attainment, health insurance status, HCP use, and reports of experienced stigma. These findings counter previous cohort studies concluding PrEP utilization is not correlated with increased reports of sexual risk behavior [14, 15, 16]. The disagreement between these findings and those previously published may be a result of temporality. AMIS is a cross-sectional survey. Individuals engaging in riskier behaviors may have been more likely to initiate PrEP, so it is possible that CAI was an indication for PrEP rather than a result of initiating PrEP. Earlier studies have suggested individuals who report feeling at higher risk for contracting HIV are more willing to initiate PrEP [19]. Importantly, decreases in condom use as a result of PrEP initiation do not negate the public health benefits of PrEP use for HIV control. A modeling study completed in 2017 found that even in the event PrEP utilization resulted in a 100% decline in condom use, the overall impact of PrEP would still be a reduction in HIV incidence [30]. However, increases in CAI after initiating PrEP may have unintended secondary consequences on the incidence of non-HIV STDs. Previous studies have suggested PrEP users are at elevated risk for non-HIV STD infection, but temporality has not been established [20, 21]. It is undetermined to what extent behavior changes follow PrEP initiation or if risk behaviors prompted PrEP use. Understanding the magnitude of the impact PrEP utilization may have on future sexual behavior and how these behaviors may translate to increased STD transmission will inform the development of future STD control measures amidst expansion of PrEP access. Because PrEP requires a prescription there are opportunities to refine provider-patient consultations to reduce STD transmission risks

and ensure patients understand the benefits and limitations of PrEP. Identifying populations in which sexual risk behaviors are more common or where PrEP utilization is low will help target these interventions.

We observed associations between PrEP utilization and race, income, and HCP use within the last 12 months. Individuals identifying as Hispanic or American Indian/Alaskan Native and those with incomes of less than $20,000 annually had a lower prevalence of PrEP use in the past 12 months compared to other demographic groups. These associations were not detected between CAI and race, income, or HCP use within the last 12 months. Although we did not observe an association between race or income and CAI, previous studies have reported that sexual risk behaviors like CAI may be associated with race and financial hardship [31, 32]. The study evaluating financial circumstances [32] was small and used self-reported financial hardship in contrast to our measure of annual income. Although limited, our findings and previous literature supports the position that the relationship between PrEP use and CAI may be confounded by race and income.

Within the AMIS cohort, respondents with lower incomes or who identified as a minority population also had a lower prevalence of PrEP use in the previous 12 months. Earlier surveys have similarly reported an association between income or race and PrEP use [14]. These groups may face additional social barriers to accessing PrEP. Because most individuals find sexual partners within their own racial and social groups [33] the negative impacts of disproportionate access to PrEP can be magnified by increasing HIV prevalence, and, therefore, HIV risk within sexual networks with low PrEP use. These findings further support a need for public health programs to expand PrEP access to these low income and minority communities.

Although a causal link between PrEP initiation and increases in CAI could not be concluded from this study, the association between PrEP use and a higher proportion of participants reporting CAI emphasizes the importance of sexual education in conjunction with improved PrEP access. If PrEP utilization does result in risk compensation behaviors PrEP users will need to understand the benefits and shortcomings of PrEP in order to inform their risk behaviors. Additional sexual health counseling presenting the severity of non-HIV STDs may encourage PrEP users to maintain some protective behaviors like regular STD testing, condom use, and limiting the number of sexual partners even in the absence of HIV transmission risk. If PrEP utilization does not result in risk compensation behavior, but individuals who perceive their risk of HIV to be high seek out PrEP, the consult required for a PrEP prescription provides an opportunity for similar counseling to encourage uptake of other protective measures.

Strengths

Existing literature has both supported the potential for risk compensation among prospective PrEP users, as well as suggested no association exists between individuals initiating PrEP use and sexual risk behaviors. This study contributes to the growing body of knowledge surrounding differences in risk behaviors in MSM utilizing PrEP. The online nature of the American Men's Internet Survey provides anonymity to participants compared to in-person interview and survey methods and increased the reach of the study. Previous studies of MSM behavior and attitudes have been conducted largely in-person where social pressure may influence respondents particularly during sensitive questions related to sexual behavior. The privacy provided by the online survey may reduce the risk of social acceptability bias and increase access to these populations. AMIS increased targeted recruitment efforts for the 2019 survey to increase racial and ethnic minority group participation, resulting in a sample that was

larger and more representative than previous studies. Finally, AMIS recruits a nationwide, diverse sample of MSM in the US.

Limitations

There were several limitations to this study. The online nature of AMIS restricts participants to individuals with internet access. The study population was a convenience sample recruited from social and sexual networking websites and previous research participants. The resulting sample may not accurately represent the US population of MSM, underrepresenting older men, individuals living in rural communities, and those of lower socioeconomic status who may not access internet sites as frequently as their counterparts. Given these biases, results from this study cannot be generalized to the entire US MSM population.

Additionally, as a cross sectional study temporality cannot be assumed. While this study presents the association between PrEP use and CAI it cannot be assumed PrEP use resulted in increases in CAI. Individuals already having CAI may have been more interested in initiating PrEP. Finally, while the final model used in this study did control for confounders identified during the literature review process, additional unknown confounders may exist.

Conclusion & Future Direction

HIV remains a public health threat and men who have sex with men continue to experience higher infection rates than the general population. Pre-exposure prophylaxis presents an opportunity to reduce HIV transmission and reduce the burden of disease. However, if PrEP use is associated with increases in sexual risk behaviors there may increases in non-HIV STDs linked to PrEP utilization. This study supported a positive association between PrEP use and CAI, and adds to the growing body of literature investigating risk compensation behaviors among MSM using PrEP. Given the link between CAI and PrEP utilization healthcare providers

should be instructed to provide sexual health counselling to patients pursuing PrEP, with an emphasis on the limitations of the preventative and the seriousness of other non-HIV STDs.

Additional longitudinal research which allows for the assessment of temporality is needed to determine if a causal link between PrEP use and CAI exist and to understand what factors modify the association between PrEP use and risk behaviors. As the relationship between PrEP and risk behavior develops more nuanced evaluations may determine during what phases of PrEP use individuals are most likely to participate in sexual risk behaviors. how soon after PrEP initiation risk compensation behaviors emerge. While risk behaviors may spike immediately after PrEP initiation as a result of a reduction in perceived risk, behaviors may return to baseline levels during sustained PrEP utilization. Identifying these risk factors will help shape public health messaging, recommendations for healthcare providers prescribing PrEP, and follow-up visits for individuals continuing or ending PrEP use.

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Tables

Table 1: Demographic and Behavioral Characteristics of the U.S MSM Completing the 2019 AMIS Cohort, By Condomless Anal Intercourse Reported in the Last 12 Months

	Total (N=9226) n(%)	No reported CAI in the last 12 months (N=2871) n(%)	Reported CAI in the last 12 months (N=6356) n(%)
Age			
Median (IQR)	26 (21-38)	25 (19-42)	26 (21-36)
15-24	4129 (44.75)	1409 (49.08)	2720 (42.79)
25-29	1693 (18.35)	372 (12.96)	1321 (20.78)
30-39	1264 (13.70)	312 (10.87)	952 (14.98)
40+	2140 (23.20)	777 (27.10)	1363 (21.44)
Race			
White	5696 (61.74)	1733 (60.38)	3963 (62.35)
Black	1088 (11.79)	352 (12.26)	736 (11.58)
Hispanic/Latino	1471 (15.94)	453 (15.78)	1018 (16.02)
Other/Multiple	971 (10.52)	332 (11.57)	639 (10.52)
Income Level			
0-19,999	1321 (16.17)	411 (17.00)	910 (15.82)
20,000-39,999	1720 (21.06)	490 (20.27)	1230 (21.39)
40,000-74,999	2333 (28.56)	659 (27.27)	1674 (29.11)
75,000+	2794 (34.21)	857 (35.46)	1937 (33.68)
Education			
No College	2165 (23.47)	856 (29.83)	1309 (20.59)
At Least Some College	7061 (76.53)	5047 (79.41)	5047 (79.41)
Health Insurance Status			
None	796 (8.88)	195 (7.05)	601 (9.69)
Private only	6553 (73.09)	1996 (72.24)	4557 (73.46)
Public only	1110 (12.38)	377 (13.64)	733 (11.82)
Other/Multiple	507 (5.65)	195 (7.05)	312 (5.03)
Experienced Stigma			
Yes	4348 (47.44)	1274 (44.89)	3074 (48.59)
No	4817 (52.56)	1564 (55.11)	3253 (51.41)
Utilized HCP in the last 12 months			
Yes	7828 (85.46)	2430 (85.32)	5398 (85.52)
No	1332 (14.54)	418 (14.68)	914 (14.48)

Null or missing values excluded from analysis

Table 2: Demographic and Behavioral Characteristics of the U.S MSM Completing the 2019 AMIS Cohort Associated with PrEP Use

	Total (N=9226) n(%)	No PrEP use in the last 12 months (N=7820) n(%)	PrEP use in the last 12 months (N=1406) n(%)	Crude Prevalence Ratios	95% Confidence Intervals
Age					
Median (IQR)	26 (21-38)	25 (20-36)	30 (25-42)		
15-24	4129 (44.75)	3809 (48.70)	320 (22.76)	REF	REF
25-29	1693 (18.35)	1332 (17.03)	361 (25.68)	2.75	2.39-3.16
30-39	1264 (13.70)	943 (12.06)	321 (22.83)	3.28	2.84-3.77
40+	2140 (23.20)	1736 (22.20)	404 (28.73)	2.43	2.12-2.79
Race					
White	5696 (61.74)	4871 (62.29)	825 (58.68)	REF	REF
Black	1088 (11.79)	838 (10.72)	250 (17.78)	1.59	1.40-1.80
Hispanic/Latino	1471 (15.94)	1282 (16.39)	189 (13.44)	0.89	0.77-1.03
Other/Multiple	971 (10.52)	829 (10.60)	142 (10.10)	1.01	0.86-1.19
Income Level					
0-19,999	1321 (16.17)	1192 (17.46)	129 (9.61)	0.51	0.43-0.62
20,000-39,999	1720 (21.06)	1477 (21.64)	243 (18.11)	0.74	0.64-0.86
40,000-74,999	2333 (28.56)	1890 (27.69)	443 (33.01)	REF	REF
75,000+	2794 (34.21)	2267 (33.21)	527 (39.27)	0.99	0.89-1.11
Education					
No College	2165 (23.47)	2040 (66.09)	125 (8.89)	REF	REF
At Least Some College	7061 (76.53)	5780 (73.91)	1281 (91.11)	3.14	2.63-3.75
Health Insurance Status					
None	796 (8.88)	737 (9.74)	59 (4.22)	0.44	0.34-0.57
Private only	6553 (73.09)	5457 (72.10)	1096 (78.45)	REF	REF
Public only	1110 (12.38)	942 (12.45)	168 (12.03)	0.90	0.78-1.05
Other/Multiple	507 (5.65)	433 (5.72)	74 (5.30)	0.87	0.70-1.08
Experienced Stigma					
Yes	4348 (47.44)	3745 (48.25)	603 (42.98)	0.84	0.76-0.92
No	4817 (52.56)	4017 (51.75)	800 (57.02)	REF	REF
Utilized HCP in the last 12 months					
Yes	7828 (85.46)	6463 (83.28)	1365 (97.57)	6.83	4.88-9.55
No	1332 (14.54)	1298 (16.72)	34 (2.43)	REF	REF

Null or missing values excluded from analysis

Table 3: Associations Between Respondent Factors and CAI among US MSM Completing the 2019 American Men's Internet Survey

	Total (N=9226) n(%)	No reported CAI in the last 12 months (N=2870) n(%)	Reported CAI in the last 12 months (N=6356) n(%)	Crude Prevalence Ratios	95% Confidence Intervals	Adjusted Prevalence Ratios*	Adjusted 95% Confidence Intervals*
Age							
Median (IQR)	26 (21-38)	25 (19-42)	26 (21-36)				
15-24	4129 (44.75)	1409 (49.08)	2720 (42.79)	REF	REF	REF	REF
25-29	1693 (18.35)	372 (12.96)	1321 (20.78)	1.18	1.15-1.22	1.10	1.06-1.14
30-39	1264 (13.70)	312 (10.87)	952 (14.98)	1.14	1.10-1.19	1.05	1.01-1.10
40+	2140 (23.20)	777 (27.10)	1363 (21.44)	0.97	0.93-1.00	0.91	0.87-0.95
Race							
White	5696 (61.74)	1733 (60.38)	3963 (62.35)	REF	REF	--	--
Black	1088 (11.79)	352 (12.26)	736 (11.58)	0.97	0..93-1.02	--	--
Hispanic/Latino	1471 (15.94)	453 (15.78)	1018 (16.02)	0.99	0.96-1.03	--	--
Other/Multiple	971 (10.52)	332 (11.57)	639 (10.52)	0.95	0.90-.99	--	--
Income Level							
0-19,999	1321 (16.17)	411 (17.00)	910 (15.82)	0.96	0.92-1.00	0.98	0.94-1.02
20,000-39,999	1720 (21.06)	490 (20.27)	1230 (21.39)	1	0.96-1.04	1	0.96-1.04
40,000-74,999	2333 (28.56)	659 (27.25)	1674 (29.11)	REF	REF	REF	REF
75,000+	2794 (34.21)	857(35.46)	1937 (33.68)	0.97	0.92-1.00	0.97	0.94-1.01
Education							
No college	2165 (23.47)	856 (29.83)	1309 (20.59)	REF	REF	REF	REF
At Least Some College	7061 (76.53)	5047 (79.41)	5047 (79.41)	1.18	1.14-1.23	1.14	1.10-1.19
Health Insurance Status							
None	796 (8.88)	195 (7.05)	601 (9.69)	1.09	1.04-1.13	--	--
Private only	6554 (73.09)	1997 (72.25)	4557 (73.46)	REF	REF	--	--
Public only	1110 (12.38)	377 (13.64)	733 (11.82)	0.95	0.91-0.99	--	--
Other/Multiple	507 (5.65)	195 (7.05)	312 (5.03)	0.88	0.82-0.95	--	--
Experienced Stigma							
Yes	4348 (47.44)	1274 (44.89)	3074 (48.59)	1.05	1.02-1.08	1.07	1.04-1.10
No	4817 (52.56)	1564 (55.11)	3253 (51.41)	REF	REF	REF	REF
Utilized HCP in the last 12 months							
Yes	7828 (85.46)	2430 (85.32)	5398 (85.52)	1.00	0.97-1.05	--	--
No	1332 (14.54)	418 (14.68)	914 (14.48)	REF	REF	--	--
PrEP Use Reported in the last 12 months							
Yes	7820 (84.76)	175 (6.10)	1231 (19.37)	1.34	1.30-1.37	1.31	1.28-1.35

No	1406 (15.24)	2695 (93.90)	5125 (80.63)	REF	REF	REF	REF

*Adjusted for age, education, income, and stigma
Null or missing values excluded from analysis
Hosmer and Lemeshow Goodness of Fit Test (Chi Square = 33.07 , p-value <0.0001)

Figures

Figure 1: Directed Acyclic Graph